

**MARKET SURVEY/REQUEST FOR
INFORMATION**

**WIDE AREA AUGMENTATION SYSTEM
(WAAS) PROGRAM**

Safety Computer

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**Federal Aviation Administration
800 Independence Avenue
Washington, D.C. 20591**

Appendix A

WAAS PROGRAM – REPLACEMENT SAFETY COMPUTER

Current Safety Computer Descriptive Information

Design Details:

The current SC design is comprised of two single board computers installed in dual Versa Module Euro Card (VME) backplanes inside a 6U, 19” rack-mounted enclosure. Along with each single board computer are two additional VME cards providing support for interrupt and Input/Output (I/O) capabilities. A custom-designed comparator circuit card assembly (CCA), power supply, and fans are also important elements of this design. A block diagram is provided in Figure 1 of Appendix A.

There are currently two versions of the SC that differ slightly depending on whether they are intended for the Wide-area Master Stations (WMS) or the Geostationary Earth Orbit (GEO) Uplink Subsystems – Type 1 (GUST). The external and internal interfaces for both types of SCs are described in Appendix A. The GUST SC has a serial interface module add-on for its processor boards that is not included on the WMS-type. The comparator card design is also different between the two types.

Note: The replacement SC should be designed to work for either a WMS or GUST installation without requiring any site-specific hardware or firmware change.

Safety Computer Design Elements

Chassis:	VME - 6U, 19” rack mount
Single Board Computers (SBC):	Motorola MVME5101-001 w/ 512 MB memory, 1MB cache w/ 100Mbps Ethernet interface
• I/O Module daughter board:	IPMC761-001
• Transition Module:	MVME761-001
• Serial Interface Module ¹ :	SIM232DCE
Operating System:	WindRiver VxWorks Cert OS V2.0.2 w/ Board Support Package
I/O Board:	GE Fanuc VMIVME2528-110
Comparator Board ² :	Custom designed (see appendix A, fig. 2)
Interrupt Board:	GE Fanuc VMIVME1101-100
External I/O ² :	Serial, Parallel, Ethernet, BNC

¹ This is only installed for GUST safety computers

² This item varies depending on whether it's a GUST or WMS type safety computer

Processor Boards: Single Board Computer (SBC), also referred to Safety Processor (SP) - The principal function of the processor(s) is to perform WAAS Message Validation, WAAS Accuracy Validation, Broadcast Message Generation, and Integrity Monitoring.

The processor boards also provide the 100Mbps Ethernet interface to the safety switch which connects to the two Corrections Processors (CP) or GUS processor.

I/O Board - The TTL I/O board provides each SP with the ability to read (Power Supply and Fan Status) and write (Reset Commands to the Comparator) via Transistor-Transistor Logic (TTL) signals.

Comparator - The Comparator is used to compare the outputs of the SP to mitigate against a hardware failure in either processor within the SC. Thus, the SC may be thought of as a collection of two independent computers and one “hardware” Comparator.

Transition Module – This module provides the interface from the SPs to the comparator.

Interrupt Board - This board provides the one pulse per second (pps) and nCOMP signal interrupt to each SP via the VME busses. The 1pps signal is used to synchronize the processors and the nCOMP signal is used to indicate a No Compare condition in the hardware (HW) Comparator.

Application Details:

All the software that resides on the two SPs in the SC is certified to Assurance Level (AL) B in accordance with RTCA/DO-178B.

The purpose of the SC within the WAAS depends on whether it is being used in a WMS or GUST installation. However, the SCs are themselves interchangeable for use in either of these applications.

For WMS Usage:

WMS-type SCs are used to validate information generated by RTCA/ DO-178B Level D assured software in the CPs and preclude broadcast of Hazardously Misleading Information (HMI) to WAAS users. The resulting outputs from the two CPs are compared by the SC’s two SPs. The SPs then independently prepare the corrections message and forwards it to the SC’s HW Comparator. The HW Comparator performs a bit-by-bit comparison of the messages produced by each SP. If the comparison finds that the outputs from the two SPs compare, the message from the master (or primary) SP is sent to all GUSTs for generation of the WAAS broadcast message. The non-master SP can receive information from the WAAS network through the CP, but send only a limited set of status messages to the WAAS Operations and Maintenance (O&M) workstation.

As data is supplied to the HW Comparator, it is stored into two independent input buffers on the Comparator, one for each SP. These buffers are exactly one message length in size, 63 bytes. Once data becomes available from each of the SPs, the HW Comparator performs a bit-by-bit comparison of the data. Normally, the comparison is successful and the message sent from the master (or primary) SP is placed into the output buffer. In the

MARKET SURVEY FOR WAAS SAFETY COMPUTER

rare event the data fails to compare, the HW Comparator reports this “miscompare” condition to each of the SPs via the No-Compare interface.

For GUST Usage:

The GUST SCs receive the to be broadcast messages from all of the SCs located at the three WMS locations via the AL D GUS processor. The SCs validate the AL B cyclic redundancy checks (CRCs) and time of applicability (TOA) of the messages and select which WMS is the source. The SCs then add the DO-229 message preamble and the 24 bit user CRC. After the message has been composed, the message is forward error correction (FEC) encoded. Each SC then sends its message to the HW Comparator which performs the bit-by-bit comparison and then, upon successful comparison, forwards the message to the Signal Generator for modulation. The master SC also performs the ranging control loop and other miscellaneous functions.

Replacement Safety Computer Requirements

The FAA seeks to develop a replacement SC that retains the dual SP and HW Comparator configuration. The HW Comparator may be required to support two data streams and may be implemented using complex hardware. Design discussions are ongoing to determine the final HW Comparator configuration. Each SP should provide processing performance at least four times (4x) the current SP, with increased memory to support additional algorithms for the second data stream. The functional design constraints require backwards compatibility to the existing SCs, and the resulting solution should be configurable to support current WAAS operations in the WMS and GUST. Existing external interfaces must be supported. See Appendix A for the description of interfaces.

To maximize compatibility with the existing WAAS application software, the FAA is seeking vendors interested in providing the Wind River certified operating system (OS), updated to a current version of the OS, with associated compiler and a board support package (BSP).

The form factor must remain rack mountable in a 19” rack with 6U front panel height or less. The backplane need not be a VME solution.

Expandability and flexibility are also considered as advantageous in this replacement SC, as it is expected to be in operational use for 15 years or more. Production and life cycle support of the SC will need to account for parts availability and maintenance of the product baseline in accordance with AL B.